IVEY BUSINESS REVIEW

HYPERLOOP PART II: IS A $20 TICKET POSSIBLE?

Despite Elon Musk's initial proposal, a $20 Hyperloop ticket is unlikely; however, $100 is entirely feasible. (model included)

2014/07/16 | Michael Zawalsky

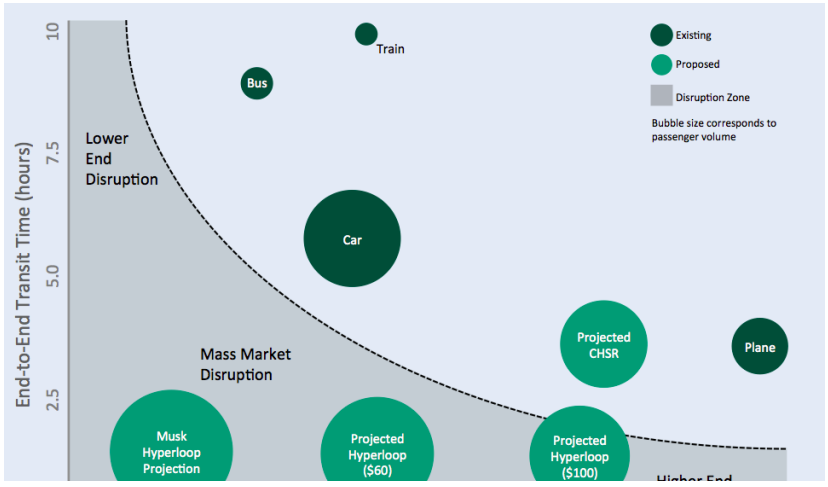
When Elon Musk introduced his Hyperloop concept in August 2013, he promised it would not only cut the 330 mile San Francisco to Los Angeles transit time down to 35 minutes, but it would do so for only $20 – less than 40% of comparable car travel costs and 20% of the proposed California High Speed Rail (CHSR). Yet, a further examination of construction costs and prospective demand suggests that delivering a $20 ticket price point may be as challenging as construction itself.

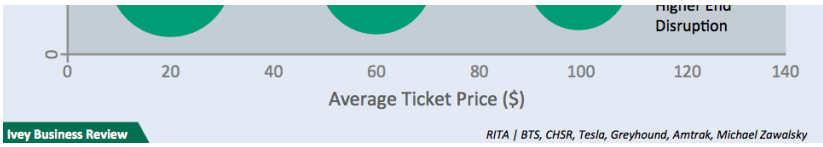
When adjusting for capital costs, operating expenses and the potential for construction delays or overruns, a $60-100 ticket appears to be a more likely starting estimate. This is, of course, a significant range (and 3-5x Musk's own estimate). However, the final price point will depend on consumer demand, and thus Hyperloop's value compared to alternate travel options. Unfortunately, even given the financial feasibility of the project, the political realities in California make it unlikely the Hyperloop will ever be built there; at least not initially.

For those interested in understanding how these values were determined, feel free to explore the financial model, adjusting various inputs to see how changes affect returns.

Passenger Demand

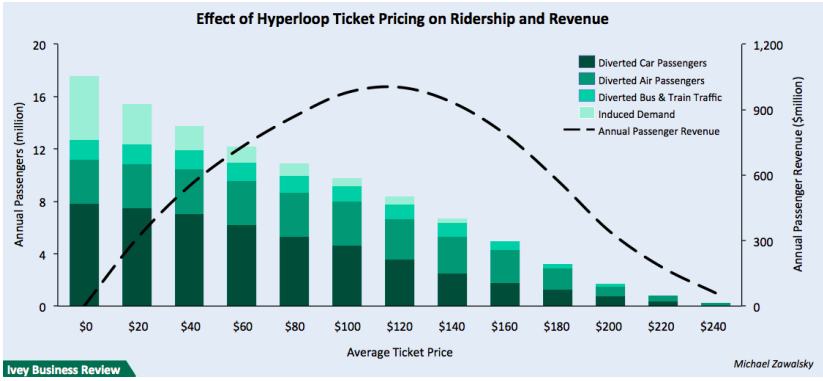
Though Hyperloop's economic viability will be heavily influenced by construction costs, its ability to recoup invested dollars will be based on its relative cost, comfort and transit time primarily relative to air and automotive travel.





Generally speaking, most disruptive innovations compete on either cost or quality and Hyperloop is no exception. Should it deliver a faster trip than air travel, it could charge a premium and compete for the high-end market. Conversely, if the ride took longer but was wildly cheaper that would serve another niche. The third option is to both provide a premium service and do it at a lower price; this is the vision that Musk proposed when he released Hyperloop and it is one that would truly be disruptive.

Hyperloop's ability to attract customers will be driven predominantly by price. Pricing relative to various other travel options will affect each customer differently based on their their income and we need to segment the population to address this. Generally, those with lower incomes will tend to choose options with lower real costs and higher time costs such as busses or trains, providing identification of key users of each mode. By further adding together the real costs and the cost of time for users we can find a total cost of each method of transport. From there we can assume that travellers will generally switch between two methods of transport when one has a lower total cost of travel. Induced demand can then be layered on top of the demand diverted from other modes.



We can then compare the demand projection from the model against Musk's projected demand and the demand projected for bay to basin transit for the CHSR at different prices. The results of this exercise predict a demand at $20 roughly 5% higher than Musk's projections, and 20-40% higher than those of the CHSR at $70 and $105; as is expected given Hyperloop has an end-to-end transit time nearly half of CHSR.

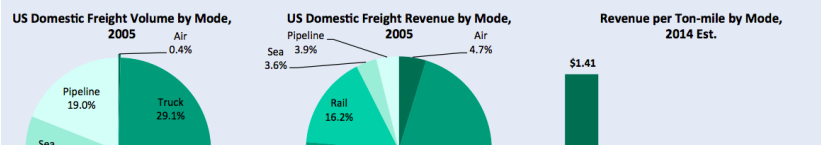
Projected revenue peaks at just over $1 billion per year with a $120 ticket, roughly 4x greater than the revenue generated using Musk's pricing and demand projections. While a $120 ticket generates peak expected revenue, tickets will likely need to be priced at a discount to ensure consumers modify their travelling behaviours. A ticket price of $60-100 would decrease expected annual revenue to $723-968 million, but would provide greater assurance that mass market adoption would occur.

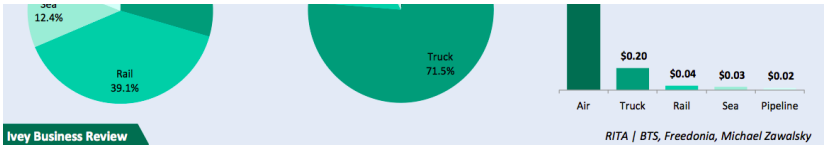
A $100 ticket price will be used for the remainder of this analysis as it generates near peak revenues while also helping to ensure consumers switch to Hyperloop. This ticket price merely represents an average price, the introduction of class based capsules and demand based pricing will allow for more effective price discrimination.

Logistics Demand

One area Musk's initial proposal overlooked was the potential for use in shipping freight. Hyperloop is particularly well suited for shipping because by design it has large over capacity (at $100 it operates at 25% capacity utilization) and there is next to no marginal cost to sending additional pods (they are unmanned and run on solar power). To fill an empty car with goods is essentially free to the Hyperloop owner, but can be charged out at rates similar to air or truck freight (whereas air and truck are high operating cost businesses).

Overall, the US logistics industry commands revenues in excess of $290 billion spread between air, trucking, rail, sea and pipeline. By volume, rail is the predominant method of transport, while trucking yields the greatest share of revenue. On a revenue per ton-mile basis (a key industry metric), air transport is by far the most lucrative option.





Air travel commands a higher price as shippers are willing to pay more to ensure that goods arrive quickly at their destination. Shipping by air between SF-LA is the segment that Hyperloop could most easily disrupt, because it can offer similarly fast shipping but at a lower cost. Based on total US domestic air shipping, the potential value of shipping that Hyperloop could capture in the SF-LA corridor is likely near $40 million.

Additionally, shipping by truck could be captured by the Hyperloop, both at current rates, but also at a premium. The advantage to air freight over other modes is fast shipping times, with customers willing to pay nearly 7x as much for air freight as for trucking; indicating there may be a market segment willing to pay a premium above current shipping prices in order for faster delivery of goods. Estimating that at least 5% of the ship by truck market would be willing to pay double the current trucking rate to use Hyperloop yields a projected annual income of just under $200 million. Beyond this premium segment, excess capacity could be filled at normal rates or at a small discount to current rates.

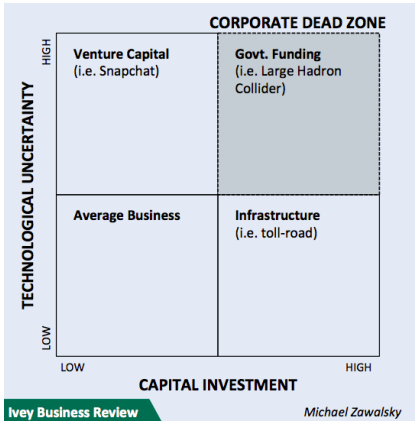
Perhaps, the greatest benefit to filling unused capsules on Hyperloop for shipping goods is that it provides a natural hedge to passenger demand. Should Hyperloop demand under perform expectations, shipping revenues would offset lost revenues, up to a maximum of $300 million / year should no passenger demand be achieved. While these revenues are smaller than the projected peak passenger revenue (of $1 billion) the shipping contracts could be signed for multi-year periods (of 5-10 years) in a take-or-pay structure similar to pipeline transport contracts. This would yield a higher quality revenue stream and provide considerable downside protection for investors.

Competitive Reaction

Airlines would be the hardest hit by the Hyperloop, standing to lose the entirety of their passenger volume in the busiest air corridor in the US. Unfortunately, airlines have few levers to compete with, with average profit per passenger of $4 airlines would need to run flights in the SF-LA corridor at a major loss to be competitively priced with Hyperloop, discounting each ticket by over $35. These losses would be further compounded by the fact that even if airlines could lower their prices sufficiently, the reduced usage would lead to fewer flights offered; further enhancing the Hyperloop value proposition. Alternatively, airlines may try and move upmarket, enhancing loyalty programs to hold on to the key business travel market.

Rather than treating Hyperloop as a competitor, airlines could partner with Hyperloop. Utilizing a code sharing agreement, airlines could direct passengers to Hyperloop transit like any other partner airline, taking a small fee for the service. While the fee would be relatively modest ($5-10, for instance, would be more profitable than operating the flights). A partnership model of this type would also help to mitigate the larger threat to airlines should additional Hyperloops be built across the country.

Sources of Investment and Required Returns



Though Hyperloop only combines existing technologies in a new way, it still carries a great deal of technological uncertainty. There are plenty of investors who are willing to put money into risky ventures – the problem is that generally they are also looking to deploy smaller amounts of capital with much shorter investment horizons (ie. venture capitalists). Meanwhile projects that require large amounts of capital are generally well understood infrastructure projects with limited risk and long-term stable cash flows (ie. toll-roads). As such, the Hyperloop, requiring both upwards of $6 billion of capital and bearing a great deal of technological uncertainty falls in a funding dead zone, a place that normally government funding is required. The issue with government funding is that it generally comes with many strings attached and delays in

development, which leads costs to spiral on a project, unless the partnership can be well structured. Especially given government support of CHSR, funding from the government is extremely unlikely, so an California Hyperloop would need to be funded privately.

Some would argue that Hyperloop provides the chance to utilize kickstarter funding; however, the most highly funded kickstarter to date was for an E-paper watch that raised just over $10 million (roughly 0.1% of the required Hyperloop funding). Conversely, it would require an average contribution of over $2,000 from every resident of San Francisco and Los Angeles to fund the project. The only place that kickstarter funding might be useful would be in development of a prototype, and even then would likely require benefactors with deep pockets, such as Musk himself. As such, an infrastructure player is is the only reasonable fit to fund the project, though in many other markets low-cost government financing and other concessions are possible.

Before investing funds in the Hyperloop an infrastructure player would want the concept to have been fully proved-out and prototyped. This would require another firm capable of completing the engineering design to take on the development of the project initially. The infrastructure player would likely then pay a fee for access to the developed intellectual property. The development firm could then license that same IP to other infrastructure players looking to build subsequent Hyperloops in other areas.

Hyperloop Projected Returns

A private infrastructure investor would normally demand an IRR (annualized rate of return) anywhere between 5-12% for an asset depending on its risk profile. A low-risk asset such as water supply infrastructure in a developed country like Canada or the US would likely be purchased for a return nearer to 5%; whereas, assets that are risky such as the Hyperloop, would demand returns north of 12%.

Assuming a $11 billion construction cost and $100 ticket price, a discounted cash flow analysis over a 40 year period suggests a return of 12.3%. While multiple factors could lead to lower returns, given the globally competitive nature of infrastructure investing, there are likely numerous players who would demonstrate an interest in the project. While to retail investors a 12% returns may seem modest, over a 40 year period it results in a 6.6x multiple of invested capital.

The two key factors affecting returns will be changes in construction costs and passenger demand. In the case of the Chunnel costs nearly doubled from estimates and passenger demand was far below expectations, ultimately leading to a massive debt restructuring. Below is a sensitivity table that incorporates modulations in ridership and construction cost for the Hyperloop.

Effect of Construction Cost and Passenger Demand on Hyperloop Project Returns

Capital Cost ($ million) \ Annual Passengers (million)	4.9	7.3	8.8	9.8	10.8	12.2	14.7
6,000	16%	23%	25%	26%	27%	29%	32%
7,000	13%	19%	20%	21%	22%	24%	26%
9,000	9%	13%	15%	16%	16%	17%	20%
11,000	7%	10%	11%	12%	13%	14%	16%
13,000	6%	8%	9%	10%	11%	12%	13%
15,000	4%	7%	8%	9%	9%	10%	12%
22,000	2%	4%	5%	5%	6%	7%	8%

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Looking at the sensitivities, there is actually a fairly compelling investment story. Even at double the projected $11 billion cost and demand half of the 9.8 million projected annual riders, an investor would still make a small return on the project. That being said, exposure to both construction risk and ridership risk is a dangerous bet. Any infrastructure investor would be wise to find another player willing to bear the risk of construction cost overruns. Should the infrastructure investor be able to enter into the contract for less than $12 billion, the Hyperloop would be a reasonably strong investment.

Interestingly, the model would suggest that a $20 ticket would actually yield a small return on investment should capital costs be held below $10 billion (at Musk's projected $6 billion cost returns are downright impressive). However, if costs rose to $11 billion or demand was 10% lower than expected the project would not pay back at a $20 ticket. If a government were looking for financial returns, albeit smaller ones, a $30-40 ticket would be feasible. However, some governments are comfortable losing money on a project if it can spur other portions of the economy. The mass market disruption generated by a low-cost Hyperloop would certainly accomplish that.

Conclusion

Despite the fact that the Hyperloop is feasible from a financial standpoint, it is unlikely to ever find success in California. With fractious politics and massive political capital sunk into the CHSR over the long-term it is extremely unlikely to ever be approved. Further, the fight to get it approved could delay the project long enough that it never gains traction in other jurisdictions (CHSR itself has been in the works for over 20 years).

As such, any player looking to build an initial Hyperloop should seek a more friendly market. The next post will examine where the best place may be.

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